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不同群落类型长苞铁杉林根际微生物研究

Studies on the rhzispheric microorganisms of *Tsuga Longibracteata* in different communities

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摘　要

长苞铁杉是我国特有的珍稀古老植物，福建省省级保护植物，它材质优良，是南岭山脉乃至广大中亚热带中海拔山地极有潜力的珍贵用材树种和生态恢复树种。本实验以长苞铁杉(*Tsuga longibracteata*)群落(TLC)、长苞铁杉+猴头杜鹃(*Rhododendron simiarum*)群落(TRC)，长苞铁杉+毛竹(*Phyllostachys pubescens*)群落(TPC)根际土壤微生物为研究对象，调查不同群落类型单位重量根际土壤和非根际土壤中的异养微生物总数；三大类微生物(细菌、放线菌、真菌)各自的数量及其在总数量中所占的比例；不同群落的根际效应；根际土壤微生物种类和根际与非根际土壤理化性质。结果如下：

1. 三个群落类型中，微生物数量及组成各不相同(单位：cfu/g·dw×10^4)：在长苞铁杉群落中：根际细菌(20.00)>非根际细菌(12.00)>根际真菌(9.37)>非根际真菌(6.74)>根际放线菌(2.69)>非根际放线菌(1.83)；在长苞铁杉＋猴头杜鹃群落中：根际细菌(34.90)>非根际细菌(18.00)>根际真菌(6.54)>非根际真菌(3.78)>根际放线菌(2.96)>非根际放线菌(1.76)；在长苞铁杉＋毛竹群落中：非根际细菌(88.00)>根际细菌(68.60)>非根际放线菌(13.40)>根际放线菌(12.60)>根际真菌(4.64)>非根际真菌(3.46)；
2. 通过比较根际与非根际土壤微生物得出不同长苞铁杉群落类型的根际效应，三大群落类型的总微生物的根际效应大小为：长苞铁杉＋猴头杜鹃群落(1.87)>长苞铁杉群落(1.56)>长苞铁杉＋毛竹群落(0.82)；
3. 从不同长苞铁杉群落的根际土壤中共分离到 8 种芽孢杆菌：蜡状芽孢杆菌(*Bacillus cereus*)、凝结芽孢杆菌(*Bacillus coagulans*)、巨大芽孢杆菌(*Bacillus megaterium*)、环状芽孢杆菌(*Bacillus circulans*)、球形芽孢杆菌(*Bacillus sphaericus*)、短小芽孢杆菌 (*Bacillus pumilus*)、短芽孢杆菌(*Bacillus brevis*)、枯草芽孢杆菌(*Bacillus subtilis*)；链霉菌属 7 个不同类群：灰褐类群(*Griseofuscus*)、烬灰类群(*Cinereus*)、青色类群(*Glaucus*)、白孢类群

(*Albosporus*)、金色类群(*Aureus*)、粉红孢类群(*Roseosporus*)、吸水类群(*Hygroscopicus*)；真菌 5 个属：青霉属(*Penicillium*)、木霉属(*Trichoderma*)、毛霉属 (*Mucor*)、被孢霉属(*Mortierella*)、伞状霉属(*Umbelopsis*)；

4. 各群落类型的 pH 值：长群落非根际土壤(4.17)>长苞铁杉＋猴头杜鹃群落非根际土壤(4.13)>长苞铁杉＋毛竹群落非根际土壤(4.03)>长群落根际土壤(4.06)>长苞铁杉＋毛竹群落根际土壤(3.94)>长苞铁杉＋猴头杜鹃群落根际土壤(3.89)；
5. 各群落类型的有机质(%)：长苞铁杉＋毛竹群落非根际土壤(3.979)>长苞铁杉＋猴头杜鹃群落根际土壤(3.855)>长苞铁杉＋毛竹群落根际土壤(3.655)>长苞铁杉群落根际土壤(3.648)>长苞铁杉＋猴头杜鹃群落非根际土壤(3.465)>长苞铁杉群落非根际土壤(3.394)；
6. 各群落类型的全 N 含量(%)：长苞铁杉＋毛竹群落非根际土壤(0.163)>长苞铁杉＋毛竹群落根际土壤(0.149)>长苞铁杉＋猴头杜鹃群落根际土壤(0.130)>长群落根际土壤(0.110)>长群落非根际土壤(0.069)>长苞铁杉＋猴头杜鹃群落非根际土壤(0.062)；
7. 各群落类型的全 P 含量(%)：长苞铁杉＋毛竹群落非根际土壤(0.020)>长苞铁杉＋猴头杜鹃群落根际土壤(0.017)>长苞铁杉＋毛竹群落根际土壤(0.016)>长群落根际土壤(0.015)>长苞铁杉＋猴头杜鹃群落非根际土壤(0.014)>长群落非根际土壤(0.013)。

关键词：长苞铁杉；根际土壤微生物；根际效应。

Abstract

Tsuga longibracteata is a kind of rare and immemorial plant listed as the protected tree in Fujian Province and is endemic to China. *Tsuga longibracteata* has good properties and it is also one important kind of potential timber tree and for restoration in the mountains of southern China.The rhizospheric microorganisms in the stand of *Tsuga longibracteata* community (TLC), the stand of *Tsuga longibracteata* + *Rhododendron simiarum* community (TRC), and the stand of *Tsuga longibracteata* + *Phyllostachys pubescens* community (TPC) in Tianbaoyan National Nature Reserve of Fujian were studied from 2004 to 2005. The result showed that:

1. The counts and composition of microorganisms in three stand are different(the unit is cfu/g·dw$\times 10^4$): In the stand of *Tsuga longibracteata* association: rhizospheric bacterium (20.00) > non-rhizospheric bacterium (12.00) > rhizospheric fungi (9.37) > non-rhizospheric fungi (6.74) > rhizospheric actinomyces (2.69) > non-rhizospheric actinomyces (1.83); In the stand of *Tsuga longibracteata* ＋ *Rhododendron simiarum* association: rhizospheric bacterium (34.90) > non-rhizospheric bacterium (18.00) > rhizospheric fungi (6.54) > non-rhizospheric fungi (3.78) > rhizospheric actinomyces (2.96) > non-rhizospheric actionmyces (1.76); In the stand of *Tsuga longibracteata* and *Phyllostachys pubescens* association: non-rhizospheric bacterium (88.00) > rhizospheric bacterium (68.60) > non-rhizospheric actinomyces (13.40) > rhizospheric actinomyces (12.60) > rhizospheric fungi (4.64) > non-rhizospheric fungi (3.46).
2. The rhizospheric effect is: the stand of *Tsuga longibracteata* + *Rhododendron simiarum* association (1.87) > the stand of *Tsuga longibracteata* association

(1.56) > the stand of *Tsuga longibracteata* + *Phyllostachys pubescens* association (0.82).

3. Eight *bacilluses* were isolated from the rhizospheric soil in the stand of *Tsuga longibracteata* association, the stand of *Tsuga longibracteata* + *Rhododendron simiarum* association and the stand of *Tsuga longibracteata* + *Phyllostachys pubescens* association: *Bacillus cereus*, *Bacillus coagulans*, *Bacillus megaterium*, *Bacillus circulans*, *Bacillus sphaericus*, *Bacillus pumilus*, *Bacillus brevis*, *Bacillus subtilis*; seven *streptomyceses* of actinomycetes: *Griseofuscus*, *Cinereus*, *Glaucus*, *Albosporus*, *Aureus*, *Roseosporus*, *Hygroscopicus*; Five major genera of the fungi: *Penicillium*, *Trichoderma*, *Mucor*, *Mortierella*, *Aspergillus*.

4. The pH in three associations were: Non-rhizospheric soil in the stand of *Tsuga longibracteata* association (4.17)> Non-rhizospheric soil in the stand of *Tsuga longibracteata* and *Rhododendron simiarum* association (4.13)> Non-rhizospheric soil in the stand of *Tsuga longibracteata* + *Phyllostachys pubescens* association (4.03)> Rhizospheric soil in the stand of *Tsuga longibracteata* association (4.06)> Rhizospheric soil in the stand of *Tsuga longibracteata* + *Phyllostachys pubescens* association(3.94)> Rhizospheric soil in the stand of *Tsuga longibracteata* + *Rhododendron simiarum* association(3.89).

5. The organic matter(%) in three associations were: Non-rhizospheric soil in the stand of *Tsuga longibracteata* + *Phyllostachys pubescens* association (3.979) > Rhizospheric soil in the stand of *Tsuga longibracteata* + *Rhododendron simiarum* association (3.855) > Rhizospheric soil in the stand of *Tsuga longibracteata* + *Phyllostachys pubescens* association (3.655) > Rhizospheric soil in the stand of *Tsuga longibracteata* association (3.648) >

Non-Rhizospheric soil in the stand of *Tsuga longibracteata* + *Rhododendron simiarum* association (3.465) > Non-rhizospheric soil in the stand of *Tsuga longibracteata* association(3.394).

6. The contents of N(%) in three associations were: Non-rhizospheric soil in the stand of *Tsuga longibracteata* + *Phyllostachys pubescens* association (0.163) > Rhizospheric soil in the stand of *Tsuga longibracteata* + *Phyllostachys pubescens* association (0.149) > Rhizospheric soil in the stand of *Tsuga longibracteata* and *Rhododendron simiarum* association (0.130) > Rhizospheric soil in the stand of *Tsuga longibracteata* association (0.112) > Non-rhizospheric soil in the stand of *Tsuga longibracteata* association (0.069) > Non-Rhizospheric soil in the stand of *Tsuga longibracteata* and *Rhododendron simiarum* association (0.062).

7. The contents of P(%) in three associations were: Non-rhizospheric soil in the stand of *Tsuga longibracteata* + *Phyllostachys pubescens* association (0.020) > Rhizospheric soil in the stand of *Tsuga longibracteata* + *Rhododendron simiarum* association (0.017) > Rhizospheric soil in the stand of *Tsuga longibracteata* + *Phyllostachys pubescens* association (0.016) > Rhizospheric soil in the stand of *Tsuga longibracteata* association (0.015) > Non-Rhizospheric soil in the stand of *Tsuga longibracteata* + *Rhododendron simiarum* association (0.014) > Non-rhizospheric soil in the stand of *Tsuga longibracteata* association (0.013).

Key words: *Tsuga longibracteata*；rhizospheric microorganisms；rhizospheric effect.

第一章 前　言

1.1 长苞铁杉国内外研究概况

长苞铁杉是我国特有树种，20 世纪 90 年代以来，国内学者开始重视对它的研究。

在群落生态学方面，邹惠渝和周晓白(1994)通过对福建几处长苞铁杉林的天然更新研究，初步揭示了火生态促进天然更新的机理[1]。王新功等(2003)对不同区域的长苞铁杉群落植物组成及其区系特征进行了比较研究[2]。

在种群生态学方面，吴继林等(1999)首次将连续型 Weibull 分布用于长苞铁杉的种群空间分布格局的研究，效果明显，根据 Weibull 分布建立了长苞铁杉种群最适量抽样式，为长苞铁杉种群抽样技术和取样数量确定提供了理论依据[3]。吴承祯等(2001)对长苞铁杉的空间分布格局进行了研究，得出长苞铁杉的空间分布呈随机分布[4]。吴承祯等(2001)通过用重要值百分数求取种间竞争系数，采用 Lotka-Volterra 竞争方程研究长苞铁杉的种间竞争关系，说明了在长苞铁杉种群支配整个群落[5]。

在森林水文学方面，钟祥顺(1999)比较了长苞铁杉天然林、常绿阔叶林和杉木人工林的林冠层、林下植被层和凋落物层的持水量、土壤蓄水能力和渗透性能，表明长苞铁杉天然林具有较好的水源涵养功能[6]。

在植物资源学方面，李维林等(2001)对长苞铁杉枝叶的挥发油成分进行了相关研究[7]。

综上所述，可以看出到目前为止国内对长苞铁杉的研究主要集中在长苞铁杉群落空间分布格局及其种群分布等方面，而对于长苞铁杉群落根际土壤微生物方面还鲜有研究。

长苞铁杉作为我国特有树种，只零星的见于我国福建、江西、广西、广